Information Technology

Providing the Industrial Perspective on IT

Master of Science (M.Sc.)
www.it-master.org

Hochschule Ostwestfalen-Lippe
University of Applied Sciences

Entrance Test

Dear prospective student: This test should assist you in finding the right Master programme. The only purpose is self assessment. Please find the solution in a separate file on the same web site. But don't betray yourself. Our recommendations concerning the number of correct answers are:

- **More than 14: This Master programme seems to be an excellent choice for you.**
- **Between 7 and 13: This Master programme seems to be okay for you, but you show some missing prerequisites which can be compensated by studying.**
- **Less than 7: You might think about choosing a different Master programme.**

Question 1 Are you willing to improve your social skills? (e.g. communication skills)

Question 2 Given an array of integer numbers, say A, with $N > 0$ places numbered from 0 to $N - 1$, programme an algorithm to find the maximum element in the array.

Question 3 Assume that x has a normal distribution with the expectation value 1. Calculate what the variance of x has to be if $P(x > 0) = 0.8$.

Question 4 What is the gradient of f (that is ∇f) if $f(x, y) = x^2 - y^2$?

Question 5 Describe the properties of a linear time-invariant (LTI) system. How can you describe the input-output behaviour mathematically?

Question 6 Digital Design: The following logical equation is given: $z = \overline{\left(B + \overline{AB} + \overline{CD}\right)}$. Calculate the result with the help of Boole's algebra. Explanation: $A + B$: A or B; AB: A and B; $\overline{A}$: not A

Question 7 Given an array of integer numbers, say A, with N places numbered from 0 to $N - 1$, calculate the sum of all values in the array.

Question 8 OOP with Java: Where in a constructor, can you place a call to a constructor defined in the super class? Select the most appropriate answer.

A: Anywhere

B: The first statement in the constructor

C: The last statement in the constructor

D: You can't call super in a constructor

Question 9 OOP with Java: Given the following classes defined in separate files:

```
class Vehicle {
    public void drive() {
        System.out.println("Vehicle: drive");
    }
}
class Car extends Vehicle {
    public void drive() {
        System.out.println("Car: drive");
        }
    }
public class Test {
    public static void main (String args []) {
        Vehicle v;
        Car c;
        v = new Vehicle();
        c = new Car();
        v.drive();
        c.drive();
        v = c;
        v.drive();
    }
}
```

What will be the effect of compiling and running this class test? Select the most appropriate answer.

A: Generates a Compiler error on the statement v= c;

B: Generates runtime error on the statement v= c;

C: Prints out:
```
Vehicle: drive
Car: drive
Car: drive
```

D: Prints out:
```
Vehicle: drive
Car: drive
Vehicle: drive
```

Question 10 The complex current equals $3\text{A} \cdot e^{j30°}$. Calculate the time dependant current $i(t)$.

Question 11 What is a FIR-Filter? What is an IIR-Filter? Describe the z-system function for both filter types.

Question 12 Consider a low-pass filter with a rectangular pass band. What is the impulse response of this filter.

Question 13 Let $\mathbf{F}_2 = GF(2) = \{0, 1\}$ be the field with two elements and let $p(x) = x^8 + 1$ and $q(x) = x^3 + x + 1$ be polynomials over $\mathbf{F}_2$. Calculate the remainder of $p(x)$ divided by $q(x)$.

Question 14 Consider the periodic binary information stream "1 0 1 0 1 0 …" . It shall be transmitted with the bitrate of 1 Mbit/s in baseband transmission using a binary modulation scheme. What is the minimal needed bandwidth?

Question 15 Calculate an eigenvector of the matrix $\begin{pmatrix} 3 & -1 \\ -1 & 3 \end{pmatrix}$

Question 16 What is true for a *m*-Code (maximal length PN-Code)?

A: *m*-Codes can be generated with feedback shift registers

B: *m*-Codes are not deterministic

C: *m*-Codes have similar behaviour like white noise

D: *m*-Code generators give a periodic signal

F: The number of "1" and "0" symbols are the same.

Question 17 For failure detection on a serial interface the technique of a parity bit is used. Determine the parity bit for the message "01101001", if "even parity" shall be used.

Question 18 Assume that a cryptographic algorithm is used to encrypt some date. Furthermore, assume that it takes 0.01 ms to decrypt a given secret (encrypted data).

How long will a *brute force attack* last (trying all possible keys) until the clear text data can be recovered, if the key length is 40 bits?

How long does such an attack take, if the keys are constructed from 5 alphanumeric characters represented by byte values in the range from 0x20 to 0x7f ?

Question 19 At a company are working 180 individuals of which 153 are men. Among the men the part who get injuries at work is 2% and among the women it is 5%. Assume that we know that there has been an injury. What is the probability that it was a woman who got injured?

Question 20 Are you willing to improve your methodical skills? (e.g. presentation skills)